(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 141 886 B1

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
18.09.2002 Bulletin 2002/38

(21) Application number: **00903197.2**

(22) Date of filing: **10.01.2000**

(51) Int Cl.[7]: **G06K 19/077**

(86) International application number:
PCT/US00/00533

(87) International publication number:
WO 00/042569 (20.07.2000 Gazette 2000/29)

(54) **LAMINATE RFID LABEL AND METHOD OF MANUFACTURE**

MEHRSCHICHTIGE RFID ETIKETTENANORDNUNG UND VERFAHREN ZU DEREN HERSTELLUNG

ETIQUETTE RFID STRATIFIEE ET SON PROCEDE DE FABRICATION

(84) Designated Contracting States:
BE DE FR GB IT NL

(30) Priority: **13.01.1999 US 229407**

(43) Date of publication of application:
10.10.2001 Bulletin 2001/41

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(56) References cited:
EP-A- 0 682 321
EP-A- 0 768 620
WO-A-98/54002

EP 1 141 886 B1

Printed by Jouve, 75001 PARIS (FR)

Description

BACKGROUND OF THE INVENTION

[0001] The field of invention is radio frequency identification (RFID) labels, more particularly a laminate label having an expandable layer.

[0002] RFID devices are known in the art, such as disclosed in U.S. Patent No. 5,347,263. These devices are used in systems for access control, animal feeding and health programs, inventory control, process control, and security applications.

[0003] A typical RFID system has a passive RFID label having circuitry therein and a separate RFID reader/writer. The RFID reader/writer energizes the RFID label circuitry by transmitting a power signal. The power signal may convey data which is stored in memory incorporated in the RFID label circuitry. In response to the power signal the RFID label circuitry may transmit a response signal containing data stored in its memory. The RFID reader/writer receives the response signal and interprets the data contained therein. The data is then transmitted to a host computer for processing.

[0004] In order to minimize the cost of labels, the labels are fabricated in large quantities. One particular method of making the RFID label is to print a conductive material, such as silver conductive ink, in a pattern defining multiple antennae, onto a substrate. The ink may be printed using silk screening techniques, such as in a sheet fed or roll operation. Once the antennae are printed, each antenna is die cut into individual pieces. Each piece is placed in a carrier where an integrated circuit (IC) chip, such as a flip chip, is electrically connected to the antenna using conventional chip attachment methods. The chip is then encapsulated in an epoxy material and the entire assembly is sandwiched between protective layers.

[0005] This particular method of making an RFID label has several drawbacks. The substrate material is expensive and when die cut, there is significant waste. Once the individual antennae are die cut into individual pieces, each piece must be loaded into a carrier for subsequent processing. If a window is not cut into the substrate, when the chip is encapsulated, there is a bump on the label which can result in the chip being easily ripped off of the label rendering the label inoperative. Finally, the bump on the chip makes putting the label through marking equipment, such as thermal transfer, ink jet, or laser printers, difficult.

[0006] Another method of manufacturing an RFID label, described in U.S. Patent 5,528,222, has an antenna formed as an integral part of an insulating substrate and a circuit chip mounted on the substrate. This particular label requires a substrate which increases the label thickness and the overall cost of the label. To minimize the label thickness, a window may be cut in the substrate allowing insertion of the chip into the window. Cutting a window in the substrate, however, further increases the cost of the label.

[0007] EP-A-0 682 321 discloses a laminated article and a method of making a laminated article in accordance with the preambles of the independent claims. More particularly, this document discloses a data carrier comprising a card body that has a cavity for receiving an integrated circuit and conducting pads for connecting an antenna. The cavity is produced by laminating a plurality of preformed layers into a multilayer body or by an injection molding process.

[0008] WO 98 54002 A discloses a plastic sheet having a through hole for receiving an integrated circuit chip of a non-contact type integrated circuit card. The plastic sheet together with the integrated circuit chip is sandwiched between two foam sheets.

[0009] EP-A 0 768 620 discloses an RFID transponder apparatus comprising a flexible substrate and an integrated circuit die mounted to a corner of the substrate. The flexible substrate is stiffened in the area of the die by thin copper stiffener sheets. A non-conducting encapsulation is placed over the die.

BRIEF SUMMARY OF THE INVENTION

[0010] The present invention provides a laminated label having a first conductive material defining electrical attachment pads; a dielectric material deposited within a label area and surrounding the attachment pads; a second conductive material defining an antenna deposited on the dielectric material and being electrically connected to the attachment pads; and an expandable material deposited in the label area, wherein expanding the expandable material forms a cavity surrounding the attachment pads for receiving an IC chip.

[0011] A general objective of the invention is to provide a label which is easy and economical to manufacture. The laminated label may be formed by silk screening the materials forming the label on a releasable liner. The laminated label is easily formed using automated equipment and it does not require a substrate.

[0012] Another objective of the present invention is to provide an RFID label having an IC chip that does not form a bump on the label surface. This objective is accomplished by forming a cavity in the label for receiving the IC chip. The cavity provides a receptacle for mounting an IC chip and avoiding a bump on the label.

[0013] These objectives are attained by the subject-matter as disclosed by claims 1 to 5, 19, and 23.

[0014] The foregoing and other objects and advantages of the invention will appear from the following description. In the description, reference is made to the accompanying drawings which form a part hereof, and in which there is shown by way of illustration a preferred embodiment of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015]

Fig. 1 is a perspective view of an RFID label incorporating the present invention;
Fig. 2 is an exploded perspective view of the label of Fig. 1;
Fig. 3 is a partial perspective view of the label of Fig. 1 showing the first four layers;
Fig. 4 is a cut-away perspective view of the label of Fig. 1; and
Fig. 5 is a sectional view of the label of Fig. 1 along line 5-5.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0016] Referring to Figs. 1, 2, and 5, a laminated RFID label 10 has five layers 14, 16, 18, 20, and 22, and forms a protective cavity 26 for RFID circuitry in the form of an IC chip 30. One of the layers 22 defines the cavity 26 for the IC chip 30, which is electrically connected to an antenna 24. The label 10 may be encapsulated or receive additional protective or functional layers 28 suitable for specific applications.

[0017] Referring to Figs. 2 and 5, the first layer 14 is an adhesive material which is deposited on a release liner 32. The release liner is preferably a silicone coated paper. However, any liner having releasable properties may be used without departing from the scope of the present invention. By forming the label 10 on the release liner 32, a substrate is not required, thus reducing the cost of the label 10.

[0018] The adhesive first layer 14 may be a UV curable pressure sensitive adhesive, such as Acheson ML25251 available from Acheson Colloids Company, Port Huron, Michigan. This layer 14 provides an adhesive surface for the finished label 10 and defines the boundary of the label area of the generally rectangular label 10. Although, the label 10 described herein is generally rectangular, the label 10 may be any shape without departing from the scope of the present invention.

[0019] The second layer 16 is an electrically conductive material which is selectively deposited onto the first layer 14. It is formed of a metallic conductive ink, such as Acheson Electrodag® 479SS available from Acheson Colloids Company, Port Huron, Michigan. The second layer 16 may be deposited using silk screening, or other methods known in the art for depositing an electrically conductive material, such as electro deposition, hot stamping, etching or the like.

[0020] As shown best in Fig. 2, the electrically conductive material 16 is deposited onto portions of the first layer 14 defining at least two landing pads 34, 35 for IC chip attachment and a cross over pass 36. The landing pads 34 provide electrical attachment pads for electrically connecting the fourth layer 20 to the IC chip 30. As more clearly described below, in cooperation with the third layer 18, the cross over pass 36 electrically connects one of the landing pads 34 to a portion of the antenna 24 without shorting out other antenna portions. Although two landing pads 34, 35 are described herein, more than two landing pads 34, 35 may be formed for connecting to the IC chip 30 without departing from the scope of the present invention.

[0021] Referring to Figs. 2 and 3, the third layer 18 is a dielectric material, such as Acheson Electrodag® 451SS available from Acheson Colloids Company, Port Huron, Michigan. It is deposited within the label boundary and it has an annular shape which surrounds a small central area 37 containing the landing pads 34, 35. The central area 37 is thus not coated with the dielectric material 18. The area 37 is sized to accommodate the IC chip 30 which is mounted over and electrically connected to the landing pads 34, 35. A conductive via 38 for electrically connecting the cross over pass 36 to the fourth layer 20 is also formed by leaving a small portion of the cross over pass 36 uncoated by the dielectric material 18.

[0022] Looking particularly at Fig. 3, the fourth layer 20 is a metallic conductive ink, such as used in the second layer 16. It is deposited onto the dielectric third layer 18 in a spiral pattern defining an antenna 24. The spiral antenna 24 has a plurality of rings including an inner ring 40 and an outer ring 42. The antenna inner ring 40 is electrically connected to one of the landing pads 34. The antenna outer ring 42 is deposited over the via 38 electrically connecting the antenna outer ring 42 to the other landing pad 35 through the cross over pass 36 without electrically contacting the other antenna rings. Although a spiral antenna is preferred and described herein, any suitable antenna shape may be used without departing from the scope of the present invention.

[0023] As shown in Fig. 2, the fifth layer 22 is shaped substantially the same as the dielectric layer 18. It is formed from an expandable material, such as a thermally expandable spacer ink comprising a binder of a polymeric resin system and an expandable additive, such as thermoplastic hollow spheres encapsulating a gas, or a blowing agent.

[0024] Preferably, the additive is thermally expandable, such as the thermoplastic hollow spheres, Expancel® 551DU, available from Expancel, Inc., Duluth, Georgia. Although Expancel® 551DU is preferred, other expandable additives, such as Expancel® 091DU, Expancel® 461DU, or blowing agents may be used without departing from the scope of the present invention. For example, blowing agents, such as diazoaminobenzene, azobis(isobutyronitrile), dinitroso pentamethylene tetramine, N,N'-dinitroso-N,N'-dimethylterephthalamide, azodicarbonamide, sulfonyl hydrazides, benzene sulfonyl hydrazide, p-toluene sulfonyl hydrazide, p,p-oxybis (benzene sulfonyl hydrazide), sulfonyl semicarbazides, decomposition products of p-toluene sulfonyl semicarbazide, esters of azodicarboxylic acid, and salts of

azodicarboxylic acid are known in art and may be combined with the binder to form the expandable layer.

[0025] The polymeric resin system includes a resin and a solvent to provide a flexible vehicle which does not degrade upon expansion of the expandable additive. The resin is preferably a polyester, however it could also be a vinyl, ethylene vinyl acetate, acrylic, polyurethane, or a combination thereof, which is mixed with a compatible solvent, such as methyl ethyl ketone, toluene, cyclohexane, glycol ether, or the like.

[0026] Preferably, the expandable fifth layer 22 is formulated, such that upon curing, it expands to a thickness substantially equal to the thickness of the epoxy encapsulated IC chip 30. For a chip height of approximately 0.35 mm, the expandable material preferably comprises no more than about 85% solvent, no more than about 30% resin, and no more than about 15% expandable additive. In the preferred embodiment, the expandable layer 22 comprises approximately 70% solvent, 23% resin, and 7% expandable additive. Typical chip heights range from approximately 0.25 - 0.9 mm and, of course, a different chip height will require a different combination of materials to provide the desired expansion of the expandable material. Although, the expandable, material preferably has a thickness substantially equal to the thickness of the encapsulated IC chip, any expandable material thickness greater or less than the IC chip height will provide some protection to the chip and may be used without departing from the scope of the invention.

[0027] Following deposition of the expandable layer 22, the laminate article 10 is cured causing the layer 22 to expand. As shown in Figs. 1, 2, 4, and 5, the expanded material surrounds the landing pads 34, 35 and defines a protective cavity 26 for receiving the IC chip 30 and an epoxy encapsulant 44. Advantageously, by providing the preferred cavity 26 for the IC chip 30 and the encapsulant 44, the IC chip 30 does not form an exposed bump on the finished label 10.

[0028] Preferably, the IC chip 10 is a flip chip having a memory and easily electrically connected to the landing pads 34 using conventional chip attachment methods. For example, once the protective cavity 26 is formed, a conductive adhesive, such as a needle dispensed polymeric conductive adhesive or an anisotropic conductive adhesive, is deposited into the cavity to electrically connect the chip 30 to each of the landing pads 34, 35. The IC chip 30 is then placed into the cavity 26 and encapsulated in the epoxy 44. The epoxy 44 deposited into the cavity 26 further protects the IC chip 30 and secures it in place. Although encapsulating the IC chip 30 with the epoxy 44 is described herein, encapsulating the chip is not required to practice the invention and in certain applications may not be desired.

[0029] One or more additional layers 28, such as a polymeric resin system comprising resins and solvents described above, may be deposited onto the fifth layer 22. The additional layers 28 may provide a layer which is compatible with thermal transfer, ink jet, or laser printing.

[0030] Alternatively, an overlaminate may be deposited on the expandable layer 22 or subsequent layers 28 to provide an adhesive surface to the laminate article 10. An overlaminate is a film, such as a polyester, cellulose acetate, vinyl, polyethylene, polypropylene, styrene, or the like, mixed with an adhesive, such as an acrylic or rubber.

[0031] Preferably, each layer 14, 16, 18, 20, and 22 is formed using a silk screening process. The silk screening process may be a sheet fed operation or a roll to roll process. The sheet fed operation will result in sheets of multiple up labels or individual labels. The roll to roll process can supply rolls of labels in addition to sheet forms provided in the sheet fed method.

[0032] Deposition of layer material on the central area 37 around the landing pads 34, 35 is prevented by placing, a releasable material, such as foam with a releasable adhesive, over the central area 37 during the silk screening process. Another method includes mounting the chip 30 prior to applying the expandable layer 22 and then notching the squeegee used in the silk screen printing process to avoid striking the chip 30.

[0033] Although silk screening is preferred, other printing or deposition techniques, such as rotogravure, may also be used without departing from the scope of the present invention. Regardless of the particular technique chosen, the same process is preferably used to sequentially form each layer 14, 16, 18, 20, and 22 of the laminate article 10.

[0034] While there has been shown and described what are at present considered the preferred embodiment of the invention, it will be obvious to those skilled in the art that various changes and modifications can be made therein without departing from the scope of the invention defined by the appended claims. For example, alternative embodiments include eliminating the adhesive first layer, encapsulating the laminate article into a formed tag, or applying the adhesive layer last.

[0035] The present invention may also be deposited onto a substrate if the release liner is not suited to the particular application and the added cost of the substrate is justified. For example, in another preferred embodiment an expandable layer may be deposited onto a conventionally formed RFID circuit with a substrate. As described above, the expandable layer forms a protective cavity for an IC chip. A laminated adhesive may then be formed on the substrate or other layers may be deposited onto the expandable layer as described above.

Claims

1. A laminated article for use as an RFID label, said article comprising:

a first conductive material (16) shaped to define two electrical attachment pads (34, 35);
a dielectric material (18) which forms a second layer that surrounds said attachment pads and extends outward therefrom to form a label boundary; and
a second conductive material (20) deposited on said dielectric material (18) and shaped to form an antenna (24) having two portions which electrically connect to the respective attachment pads; **characterized by**:

an expandable material (22) disposed over the antenna (24) and extending inward from the label boundary to define a protective cavity (26) surrounding said attachment pads (34, 35), wherein said expandable material (22) is selected from a group consisting of a thermally expandable ink and a binder including an expandable additive, and expanding the expandable material (22) increases the height of the protective cavity (26).

2. A laminated article for use as an RFID label, said article comprising:

a first conductive material (16) shaped to define two electrical attachment pads (34, 35);
a dielectric material (18) which forms a second layer that surrounds said attachment pads and extends outward therefrom to form a label boundary; and
a second conductive material (20) deposited on said dielectric material and shaped to form an antenna (24) having two portions (40, 42) which electrically connect to the respective attachment pads; **characterized by**:

an expandable material (22) disposed over the antenna (24) and extending inward from the label boundary to define a protective cavity (26) surrounding said attachment pads (34, 35), wherein expanding the expandable material (22) increases the height of the protective cavity (26), and said expandable (22) material can be applied by printing.

3. A laminate RFID label having an integrated circuit chip (30) mounted thereon, **characterized by**:

a layer of expandable material (22) which extends inward from a tag boundary to define a protective cavity (26) that surrounds the integrated circuit chip (30) and being curable to expand in thickness, wherein said expandable material (22) is selected from a group consisting of a thermally expandable ink and a binder including an expandable additive.

4. A laminate RFID label having an integrated circuit chip (30) mounted thereon, **characterized by**:

a layer of expandable material (22) which extends inward from a tag boundary to define a protective cavity (26) that surrounds the integrated circuit chip (30) and being curable to expand in thickness, wherein said integrated circuit chip (30) has a thickness and said expandable material (22) is expandable to a thickness substantially equal to said chip thickness.

5. A laminate RFID label having an integrated circuit chip (30) mounted thereon, **characterized by**:

a layer of expandable material (22) which extends inward from a tag boundary to define a protective cavity (26) that surrounds the integrated circuit chip (30) and being curable to expand in thickness, and said layer of expandable material (22) can be applied by printing.

6. The laminated article as in claim 1 or 2, which includes an adhesive layer (14) that supports the first conductive material (16) and the dielectric material (18).

7. The laminated article as in claim 6, in which the adhesive layer (14) is supported by a releasable liner (32).

8. The laminated article as in any one of the claims 1, 2, 6 or 7, further comprising an integrated circuit chip (30) which is received in said protective cavity (26) and electrically connects to said attachment pads (34, 35).

9. The laminated article as in claim 8, further comprising an encapsulating material (44) encapsulating said integrated circuit chip (30) in said protective cavity (26).

10. The laminated article as in claim 8 or 9, wherein said integrated circuit chip (30) has a thickness and said expandable material (22) is expanded to a thickness substantially equal to said chip thickness.

11. The laminated article as in any one of the claims 1, 2 or 6 to 10, wherein said first conductive material (16) defines a cross over pass (36) for electrically connecting one portion (42) of the antenna (24) to one (35) of the electrical attachment pads (34, 35).

12. The laminated article as in claim 1 or the laminate RFID label as in claim 3, wherein said binder is a

polymeric resin system.

13. The laminated article or the laminated RFID label as in claim 12, wherein said polymeric resin system comprises a resin selected from the group consisting of a polyester, vinyl, ethylene vinyl acetate, acrylic, polyurethane, or a combination thereof.

14. The laminated article or the laminate RFID label as in claim 12, wherein said polymeric resin system comprises a solvent selected from the group consisting of methyl ethyl ketone, toluene, cyclohexane and a glycol ether.

15. The laminated article as in claim 1 or the laminate RFID label as in claim 3, wherein said expandable additive is thermoplastic hollow spheres containing a gas.

16. The laminated article as in claim 1 or the laminate RFID label as in claim 3, wherein said expandable additive is blowing agent.

17. The laminated article as in claim 1 or 2, wherein said label (10) is encapsulated in a material to form a tag.

18. The laminate RFID label as in any one of the claims 3 to 5, wherein said label (10) includes a substrate.

19. A method of making a laminated article for use as an RFID label comprising the steps of:

depositing a first electrically conductive material (16) to form two attachment pads (34, 35); depositing a dielectric material (18) in a layer surrounding said attachment pads (34, 35); and depositing a second electrically conductive material (20) onto said dielectric material (18), said second electrically conducting material being shaped to define an antenna (24); **characterized by** the further steps of:

depositing an expandable material (22) in a layer surrounding said attachment pads (34, 35), wherein said expandable material (22) is selected from a group consisting of a thermally expandable ink and a binder including an expandable additive; and
expanding said expandable material (22) to form a protective cavity (26) containing said attachment pads (34, 35).

20. The method of making a laminated article as in claim 19, further comprising the step of mounting an integrated circuit chip (30) in the protective cavity (26) and connecting it to said attachment pads (34, 35).

21. The method of making a laminated article as in claim 19 or 20, further comprising the step of covering an area surrounding said attachment pads (34, 35) with a releasable material (32).

22. The method of making a laminated article as in any one of the claims 19 to 21, further comprising the step of encapsulating the laminated article with a material to form an RFID tag.

23. A method of making a laminated article for use as an RFID label comprising the steps of:

depositing a first electrically conductive material (16) to form two attachment pads (34, 35); depositing a dielectric material (18) in a layer surrounding said attachment pads (34, 35); and depositing a second electrically conductive material (20) onto said dielectric material (18), said second electrically conducting material (20) being shaped to define an antenna (24); **characterized by** the further steps of:

depositing an expandable material (22) in a layer surrounding said attachment pads (34, 35) wherein said expandable material (22) is deposited by printing; and
expanding said expandable material (22) to form a protective cavity (26) containing said attachment pads (34, 35).

Patentansprüche

1. Mehrschichtige Anordnung zur Verwendung als RFID Etikett, welche Anordnung umfaßt:

ein erstes leitendes Material (16), das so geformt ist, daß es zwei elektrische Befestigungspads (34, 35) definiert;
ein dielektrisches Material (18), welches eine zweite Schicht bildet, die die Befestigungspads umgibt und sich von diesen zur Ausbildung einer Etikettbegrenzung auswärts erstreckt; und ein zweites leitendes Material (20), das auf dem dielektrischen Material (18) aufgebracht ist und zur Ausbildung einer Antenne (24) geformt ist, die zwei Abschnitte umfaßt, welche elektrisch mit den jeweiligen Befestigungspads in Verbindung stehen; **gekennzeichnet durch**:

ein expandierbares Material (22), das über der Antenne (24) angeordnet ist und sich von der Etikettenbegrenzung einwärts erstreckt, um eine Schutzaushöhlung (26) zu begrenzen, die die Befestigungspads (34, 35) umgibt, wobei das expandierbare Material (22) aus einer Gruppe ausgewählt ist,

die aus einem thermisch expandierbaren Farbstoff und einem Bindemittel ausgewählt ist, das einen expandierbaren Zusatz umfaßt, und wobei die Expansion des expandierbaren Materials (22) die Höhe der Schutzaushöhlung (26) vergrößert.

2. Mehrschichtige Anordnung zur Verwendung als RFID Etikett, welche Anordnung umfaßt:

ein erstes leitendes Material (16), das so geformt ist, daß es zwei elektrische Befestigungspads (34, 35) definiert;
ein dielektrisches Material (18), welches eine zweite Schicht bildet, die die Befestigungspads umgibt und sich von diesen zur Ausbildung einer Etikettbegrenzung auswärts erstreckt; und ein zweites leitendes Material (20), das auf dem dielektrischen Material (18) aufgebracht ist und zur Ausbildung einer Antenne (24) geformt ist, die zwei Abschnitte (40, 42) umfaßt, welche elektrisch mit den jeweiligen Befestigungspads in Verbindung stehen; **gekennzeichnet durch**:

ein expandierbares Material (22), das über der Antenne (24) angeordnet ist und sich von der Etikettenbegrenzung einwärts erstreckt, um eine Schutzaushöhlung (26) zu begrenzen, die die Befestigungspads (34, 35) umgibt, wobei die Expansion des expandierbaren Materials (22) die Höhe der Schutzaushöhlung (26) vergrößert und das expandierbare Material (22) **durch** Drucken aufbringbar ist.

3. Mehrschichtiges RFID Etikett, aufweisend einen darauf angebrachten Chip (30) mit integrierter Schaltung, **gekennzeichnet durch**:

eine Schicht eines expandierbaren Materials (22), welche sich von einer Etikettbegrenzung einwärts erstreckt, um eine Schutzaushöhlung (26) zu definieren, die den Chip (30) mit integrierter Schaltung umgibt und so aushärtbar ist, daß sie dickenmäßig expandiert, wobei das expandierbare Material (22) aus einer Gruppe ausgewählt ist, die aus einem thermisch expandierbaren Farbstoff und einem Bindemittel besteht, welches einen expandierbaren Zusatz umfaßt.

4. Mehrschichtiges RFID Etikett, aufweisend einen darauf angebrachten Chip (30) mit integrierter Schaltung, **gekennzeichnet durch**:

eine Schicht eines expandierbaren Materials (22), welche sich von einer Etikettbegrenzung einwärts erstreckt, um eine Schutzaushöhlung (26) zu definieren, die den Chip (30) mit integrierter Schaltung umgibt und so aushärtbar ist, daß sie dickenmäßig expandiert, wobei der Chip (30) mit integrierter Schaltung eine Dicke aufweist und das expandierbare Material (22) auf eine Dicke expandierbar ist, die im wesentlichen gleich dieser Chipdicke ist.

5. Mehrschichtiges RFID Etikett, aufweisend einen darauf angebrachten Chip (30) mit integrierter Schaltung, **gekennzeichnet durch**:

eine Schicht eines expandierbaren Materials (22), welche sich von einer Etikettbegrenzung einwärts erstreckt, um eine Schutzaushöhlung (26) zu definieren, die den Chip (30) mit integrierter Schaltung umgibt und so aushärtbar ist, daß sie dickenmäßig expandiert, wobei die Schicht aus expandierbarem Material (22) **durch** Drukken aufbringbar ist.

6. Mehrschichtanordnung nach Anspruch 1 oder 2, welche eine adhesive Schicht (14) umfaßt, die das erste leitende Material (16) und das dielektrische Material (18) trägt.

7. Mehrschichtanordnung nach Anspruch 6, in welcher die adhesive Schicht (14) von einer Release-Unterlage (32) getragen wird.

8. Mehrschichtige Anordnung nach einem der Ansprüche 1, 2, 6 oder 7, ferner aufweisend einen Chip (30) mit integrierter Schaltung, welcher in der Schutzaushöhlung (26) aufgenommen ist und elektrisch mit den Befestigungspads (34, 35) verbunden ist.

9. Mehrschichtanordnung nach Anspruch 8, ferner aufweisend ein Einkapselungsmaterial (44), welches den Chip (30) mit integrierter Schaltung in der Schutzaushöhlung (26) einkapselt.

10. Mehrschichtanordnung nach Anspruch 8 oder 9, in welcher der Chip (30) mit integrierter Schaltung eine Dicke aufweist und das expandierbare Material (22) auf eine Dicke im wesentlichen gleich dieser Chipdicke expandiert wird.

11. Mehrschichtanordnung nach einem der Ansprüche 1, 2 oder 6 bis 10, in welcher das erste leitende Material (16) eine Überleitung (36) zur elektrischen Verbindung eines Abschnitts (42) der Antenne (24) mit einem (35) der elektrischen Befestigungspads (34, 35) definiert.

12. Mehrschichtanordnung nach Anspruch 1 oder Mehrschicht RFID Etikett nach Anspruch 2, in welchen das Bindemittel ein Polymer-Harzsystem ist.

13. Mehrschichtanordnung oder Mehrschicht RFID Etikett nach Anspruch 12, in welchen das Polymer-Harzsystem ein Harz umfaßt, das aus der Gruppe ausgewählt ist, welche einen Polyester, Vinyl, Ethylen-Vinylacetat, Acrylharz, Polyurethan oder eine Kombination hiervon umfaßt.

14. Mehrschichtanordnung oder Mehrschicht RFID Etikett nach Anspruch 12, in welchen das Polymer-Harzsystem ein Lösemittel umfaßt, das aus der Gruppe ausgewählt ist, die aus Methylethylketon, Toluol, Cyclohexan und Glycolether besteht.

15. Mehrschichtanordnung nach Anspruch 1 oder Mehrschicht RFID Etikett nach Anspruch 3, in welchen der expandierbare Zusatz aus thermoplastischen Hohlkugeln besteht, die ein Gas enthalten.

16. Mehrschichtanordnung nach Anspruch 1 oder Mehrschicht RFID Etikett nach Anspruch 3, in welchen der expandierbare Zusatz ein Treibmittel ist.

17. Mehrschichtanordnung nach Anspruch 1 oder 2, in welcher das Etikett (10) zur Ausbildung eines Ktebeetiketts in einem Material eingekapselt ist.

18. Mehrschicht RFID Etikett nach einem der Ansprüche 3 bis 5, in welchem das Etikett (10) ein Substrat umfaßt.

19. Verfahren zum Herstellen einer Mehrschichtanordnung zur Verwendung als RFID Etikett, umfassend die Schritte:

    Aufbringen eines ersten elektrisch leitenden Materials (16) zur Ausbildung zweier Befestigungspads (34, 35);
    Aufbringen eines dielektrischen Materials (18) in einer die Befestigungspads (34, 35) umgebenden Schicht; und
    Aufbringen eines zweiten elektrisch leitenden Materials (20) auf dem dielektrischen Material (18), wobei das zweite elektrisch leitende Material zur Definition einer Antenne (24) geformt ist; **gekennzeichnet durch** die weiteren Schritte:

        Aufbringen eines expandierbaren Materials (22) in einer die Befestigungspads (34, 35) umgebenden Schicht, wobei das expandierbare Material (22) aus einer Gruppe ausgewählt ist, die einen thermisch expandierbaren Farbstoff und ein Bindemittel umfaßt, welches einen expandierbaren Zusatz umfaßt; und
        Expandieren des expandierbaren Materials (22) zur Bildung einer Schutzaushöhlung (26), welche die Befestigungspads (34, 35) enthält.

20. Verfahren zum Herstellen einer Mehrschichtanordnung nach Anspruch 19, ferner aufweisend den Schritt der Anbringung eines Chips (30) mit integrierter Schaltung in der Schutzaushöhlung (26) und der Verbindung des Chips mit den Befestigungspads (34, 35).

21. Verfahren zum Herstellen einer Mehrschichtanordnung nach Anspruch 19 oder 20, ferner umfassend den Schritt des Abdeckens eines die Befestigungspads (34, 35) umgebenden Bereichs mit einem Release-Material (32).

22. Verfahren zum Herstellen einer Mehrschichtanordnung nach einem der Ansprüche 19 bis 21, ferner aufweisend den Schritt des Einkapselns der Mehrschichtanordnung mit einem Material zur Ausbildung eines RFID Klebeetiketts.

23. Verfahren zum Herstellen einer Mehrschichtanordnung zur Verwendung als RFID Etikett, umfassend die Schritte:

    Aufbringen eines ersten elektrisch leitenden Materials (16) zur Ausbildung zweier Befestigungspads (34, 35);
    Aufbringen eines dielektrischen Materials (18) in einer die Befestigungspads (34, 35) umgebenden Schicht; und
    Aufbringen eines zweiten elektrisch leitenden Materials (20) auf dem dielektrischen Material (18), wobei das zweite elektrisch leitende Material zur Definition einer Antenne (24) geformt ist; **gekennzeichnet durch** die weiteren Schritte:

        Aufbringen eines expandierbaren Materials (22) in einer die Befestigungspads (34, 35) umgebenden Schicht, wobei das expandierbare Material (22) **durch** Drucken aufgebracht wird; und
        Expandieren des expandierbaren Materials (22) zur Ausbildung einer Schutzaushöhlung (26), die die Befestigungspads (34, 35) enthält.

Revendications

1. Article stratifié destiné à être utilisé en tant qu'étiquette RFID, ledit article comprenant :

    un premier matériau conducteur (16) formé de manière à définir deux patins électriques de fixation (34, 35) ;
    un matériau diélectrique (18) qui forme une se-

conde couche qui entoure lesdits patins de fixation et qui s'étend vers l'extérieur à partir de ceux-ci, afin de former une délimitation d'étiquette ; et
un second matériau conducteur (20) déposé sur ledit matériau diélectrique (18) et ayant une forme destinée à former une antenne (24) comportant deux parties qui sont en connexion électrique avec les patins de fixation respectifs ;

caractérisé par :

un matériau à expansion (22) disposé sur l'antenne (24) et qui s'étend vers l'intérieur à partir de la délimitation de l'étiquette, afin de définir une cavité protectrice (26) qui entoure lesdits patins de fixation (34, 35), dans lequel ledit matériau à expansion (22) est sélectionné à partir d'un groupe se composant d'une encre à expansion thermique et d'un liant comprenant un additif à expansion, et dans lequel le matériau à expansion (22) augmente la hauteur de la cavité protectrice (26).

2. Article stratifié destiné à être utilisé en tant qu'étiquette RFID, ledit article comprenant :

un premier matériau conducteur (16) formé de manière à définir deux patins électriques de fixation (34, 35) ;
un matériau diélectrique (18) qui forme une seconde couche qui entoure lesdits patins de fixation et qui s'étend vers l'extérieur à partir de ceux-ci, afin de former une délimitation d'étiquette ; et
un second matériau conducteur (20) déposé sur ledit matériau diélectrique (18) et ayant une forme destinée à former une antenne (24) comportant deux parties (40, 42) qui sont en connexion électrique avec les patins de fixation respectifs ;

caractérisé par :

un matériau à expansion (22) disposé sur l'antenne (24) et qui s'étend vers l'intérieur à partir de la délimitation de l'étiquette, afin de définir une cavité protectrice (26) qui entoure lesdits patins de fixation (34, 35), dans lequel la dilatation du matériau à expansion (22) augmente la hauteur de la cavité protectrice (26), et ledit matériau à expansion (22) peut être appliqué par impression.

3. Étiquette stratifiée RFID comportant une puce à circuit intégré (30) montée sur celle-ci, **caractérisée par :**

une couche de matériau à expansion (22) qui s'étend vers l'intérieur à partir d'une délimitation de l'étiquette, afin de définir une cavité protectrice (26) qui entoure la puce à circuit intégré (30) et qui est capable de s'étendre en épaisseur, dans laquelle ledit matériau à expansion (22) est sélectionné à partir d'un groupe se composant d'une encre à expansion thermique et d'un liant comprenant un additif à expansion.

4. Étiquette stratifiée RFID comportant une puce à circuit intégré (30) montée sur celle-ci, **caractérisée par :**

une couche de matériau à expansion (22) qui s'étend vers l'intérieur à partir d'une délimitation de l'étiquette, afin de définir une cavité protectrice (26) qui entoure la puce à circuit intégré (30) et qui est capable de se dilater en épaisseur, dans laquelle ladite puce à circuit intégré (30) a une certaine épaisseur et dans laquelle ledit matériau à expansion (22) peut se dilater jusqu'à une épaisseur essentiellement égale à l'épaisseur de ladite puce.

5. Étiquette stratifiée RFID comportant une puce à circuit intégré (30) montée sur celle-ci, **caractérisée par :**

une couche de matériau à expansion (22) qui s'étend vers l'intérieur à partir d'une délimitation de l'étiquette, afin de définir une cavité protectrice (26) qui entoure la puce à circuit intégré (30) et qui est capable de se dilater en épaisseur, dans laquelle ladite couche matériau à expansion (22) peut être appliquée par impression.

6. Article stratifié selon la revendication 1 ou la revendication 2, qui comprend une couche adhésive (14) qui supporte le premier matériau conducteur (16) et le matériau diélectrique (18).

7. Article stratifié selon la revendication 6, dans lequel la couche adhésive (14) est supportée par une doublure amovible (32).

8. Article stratifié selon l'une quelconque des revendications 1, 2, 6 ou 7, comprenant en outre une puce à circuit intégré (30) qui est reçue dans ladite cavité protectrice (26) et qui est en connexion électrique avec lesdits patins de fixation (34, 35).

9. Article stratifié selon la revendication 8, comprenant en outre un matériau d'enrobement (44) qui enrobe ladite puce à circuit intégré (30) dans ladite cavité protectrice (26).

10. Article stratifié selon la revendication 8 ou la revendication 9, dans lequel ladite puce à circuit intégré (30) a une certaine épaisseur et dans lequel ledit matériau à expansion se dilate à une épaisseur essentiellement égale à l'épaisseur de ladite puce.

11. Article stratifié selon l'une quelconque des revendications 1, 2 ou 6 à 10, dans lequel ledit premier matériau conducteur (16) définit un passage de transition (36) destiné à la connexion électrique entre une partie de l'antenne (24) et l'un (35) des patins électriques de fixation (34, 35).

12. Article stratifié selon la revendication 1 ou étiquette stratifiée RFID selon la revendication 3, dans lequel ledit liant est un système de résines polymères.

13. Article stratifié ou étiquette stratifiée RFID selon la revendication 12, dans lequel ledit système de résines polymères comprend une résine sélectionnée à partir d'un groupe se composant de polyester, de vinyle, d'acétate de vinyle éthylénique, d'acrylique, de polyuréthanne, ou d'une combinaison de ceux-ci.

14. Article stratifié ou étiquette stratifiée RFID selon la revendication 12, dans lequel ledit système de résines polymères comprend un solvant sélectionné à partir d'un groupe se composant de cétone d'éthyle méthylique, de toluène, de cyclohexane et d'éther de glycol.

15. Article stratifié selon la revendication 1 ou étiquette stratifiée RFID selon la revendication 3, dans lequel ledit additif à expansion se compose de sphères creuses thermoplastiques contenant un gaz.

16. Article stratifié selon la revendication 1 ou étiquette stratifiée RFID selon la revendication 3, dans lequel ledit additif à expansion est un agent d'expansion.

17. Article stratifié selon la revendication 1 ou la revendication 2, dans lequel ladite étiquette (10) est enrobée dans un matériau afin de former une étiquette.

18. Étiquette stratifiée RFID selon l'une quelconque des revendications 3 à 5, dans laquelle ladite étiquette (10) comprend un substrat.

19. Procédé de fabrication d'un article stratifié destiné à être utilisé comme étiquette RFID comprenant les étapes de :

dépôt d'un premier matériau conducteur électrique (16) afin de former deux patins de fixation (34, 35) ;
dépôt d'un matériau diélectrique (18) dans une couche entourant lesdits patins de fixation (34, 35) ; et
dépôt d'un second matériau conducteur électrique (20) sur ledit matériau diélectrique (18), ledit second matériau conducteur électrique étant formé de manière à définir une antenne (24) ;

caractérisé par les autres étapes de :

dépôt d'un matériau à expansion (22) dans une couche entourant lesdits patins de fixation (34, 35), dans laquelle ledit matériau à expansion (22) est sélectionné à partir d'un groupe se composant d'une encre à expansion thermique et d'un liant comprenant un additif à expansion ; et
dilatation dudit matériau à expansion (22) afin de former une cavité protectrice (26) contenant lesdits patins de fixation (34, 35).

20. Procédé de fabrication d'un article stratifié selon la revendication 19, comprenant en outre l'étape de montage d'une puce à circuit intégré (30) dans la cavité protectrice (26) et de sa connexion aux dits patins de fixation (34, 35).

21. Procédé de fabrication d'un article stratifié selon la revendication 19 ou la revendication 20, comprenant en outre l'étape de recouvrement d'une surface entourant lesdits patins de fixation (34, 35) avec un matériau amovible (32).

22. Procédé de fabrication d'un article stratifié selon l'une quelconque des revendications 19 à 21, comprenant en outre l'étape d'enrobement de l'article stratifié avec un matériau, afin de former une étiquette RFID.

23. Procédé de fabrication d'un article stratifié destiné à être utilisé comme étiquette RFID comprenant les étapes de :

dépôt d'un premier matériau conducteur électrique (16), afin de former deux patins de fixation (34, 35) ;
dépôt d'un matériau diélectrique (18) dans une couche entourant lesdits patins de fixation (34, 35) ; et
dépôt d'un second matériau conducteur électrique (20) sur ledit matériau diélectrique (18), ledit second matériau conducteur électrique (20) étant formé de manière à définir une antenne (24) ;

caractérisé par les autres étapes de :

dépôt d'un matériau à expansion (22) dans une

couche entourant lesdits patins de fixation (34, 35), dans laquelle ledit matériau à expansion (22) est déposé par impression ; et

dilatation dudit matériau à expansion (22), afin de former une cavité protectrice (26) contenant lesdits patins de fixation (34, 35).

FIG. 1

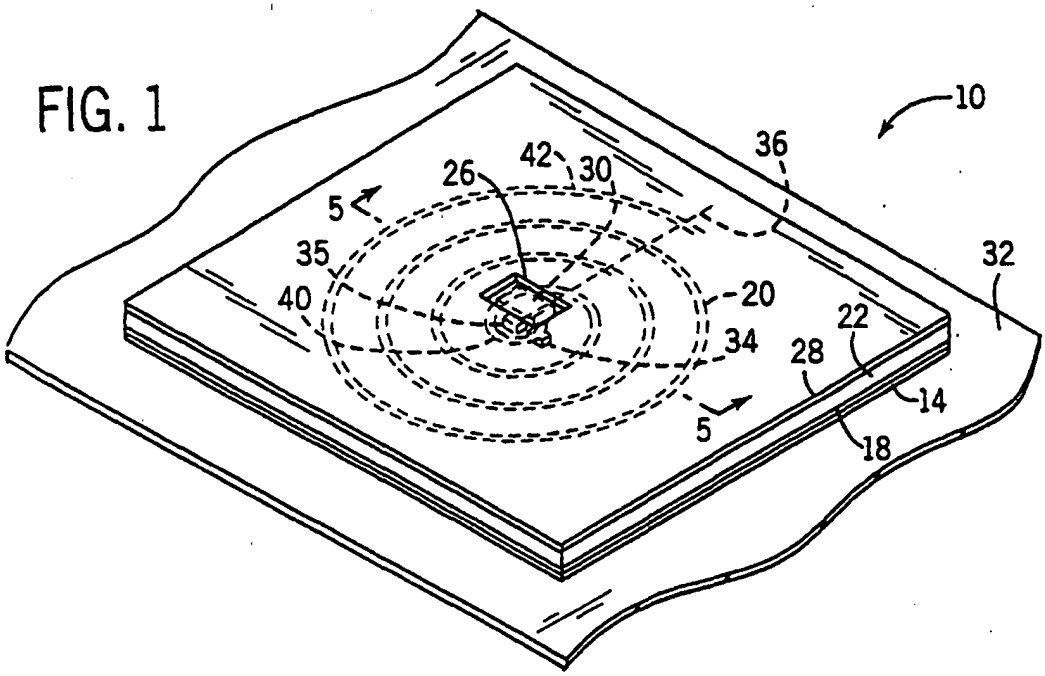
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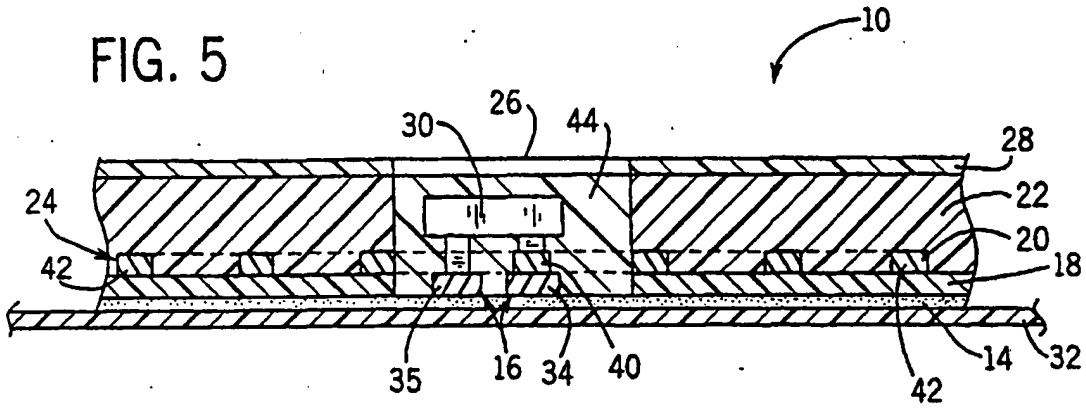
FIG. 5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42

FIG. 2

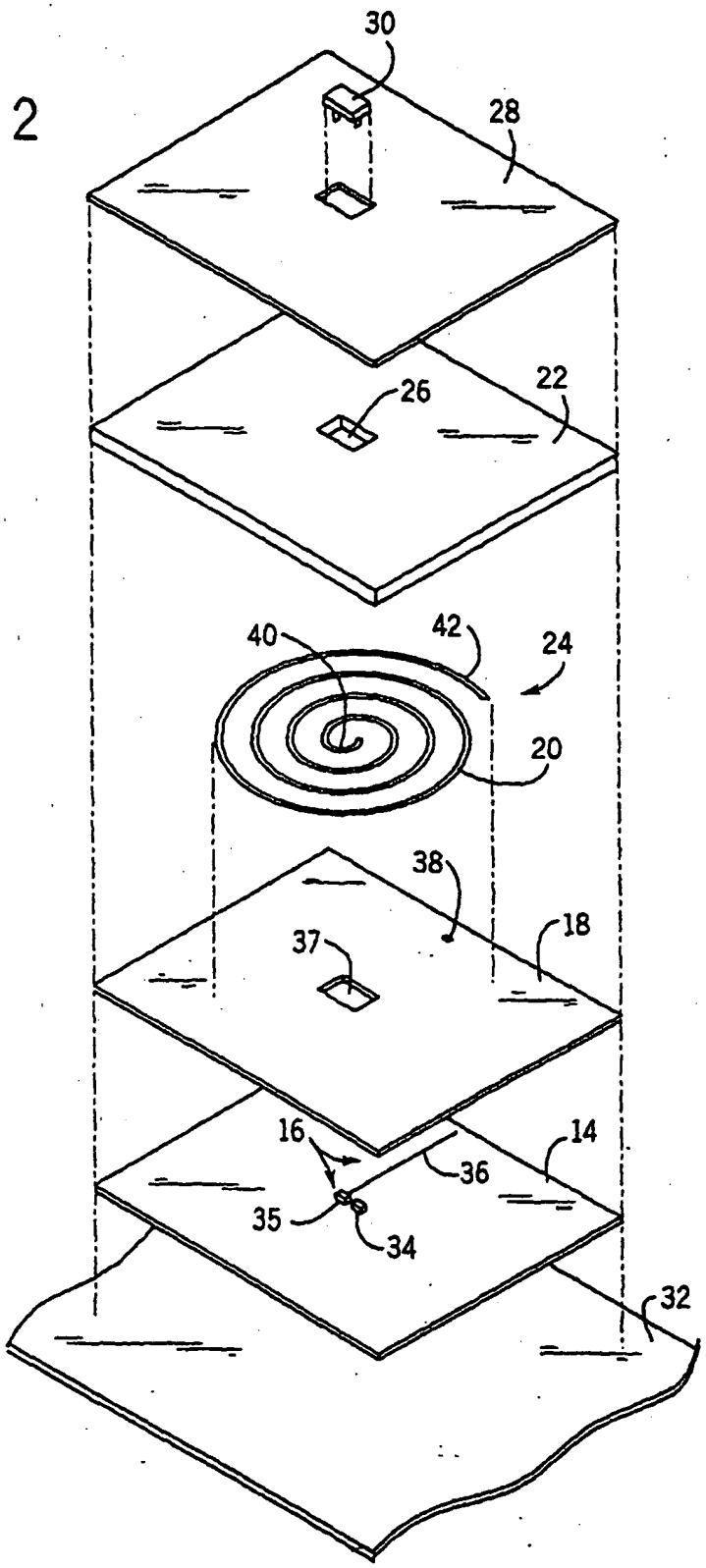

FIG. 3

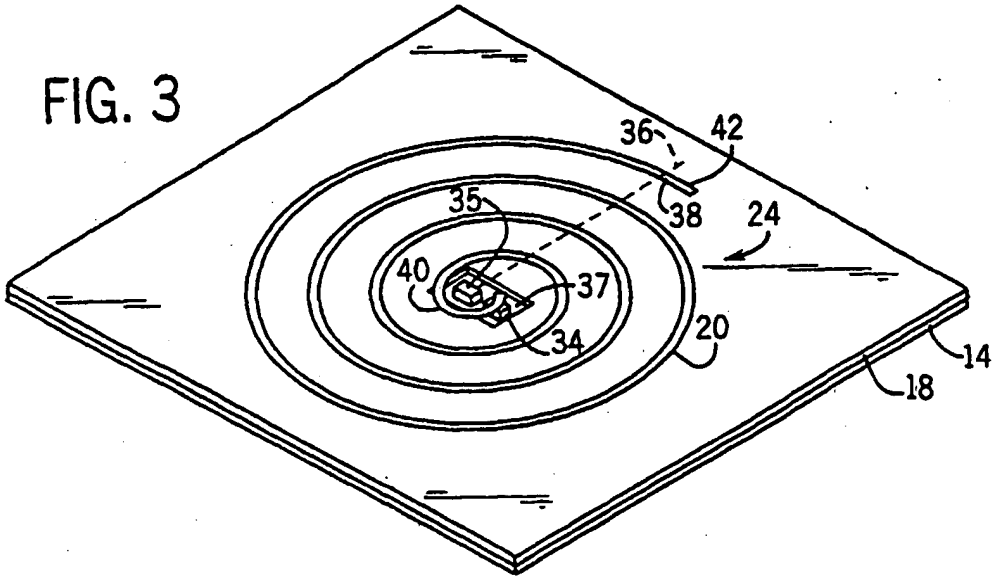

FIG. 4